

Title of the Invention



METHOD OF MANUFACTURING MULTILAYER CIRCUIT BOARD

BACKGROUND OF THE INVENTION

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(1) Field of the Invention

The present invention relates to a method of manufacturing a multilayer circuit board.

(2) Description of Related Art

The build-up process is well known as a conventional method of manufacturing a multilayer circuit board. For example, a multilayer circuit board is manufactured as follows in this process. Firstly, via holes are formed at prescribed positions in a one-side copper-clad laminate manufactured by applying a copper foil to one side of an insulating substrate. The via holes are filled with an electrically conductive paste. A copper foil is bonded to the insulating substrate side of the one-side copper-clad laminate by pressing etched so that a prescribed conductor circuit is formed.

A printed board manufactured as described above serves as a core board. Insulating substrates are stacked on both sides of the core board respectively and bonded by pressing. Thereafter, via holes are formed at prescribed positions and then filled with the conductive paste. After copper foils are stacked on both sides of the board and pressed again, prescribed conductor circuits are formed on each copper foil. This step is repeated to further increase the number of layers so that a multilayer circuit board is manufactured.

In the foregoing method, the printed board serving as the core board is manufactured and circuit patterns are sequentially stacked on the core board. Accordingly, since the

number of steps is increased, there is a definite limit on how much one can improve the manufacturing efficiency.

Furthermore, manufacture of the core board requires a step of bonding a copper foil by pressing in a conventional method. The pressing sometimes distorts the insulating substrate of the core board, causing positions of the via holes formed in the insulating substrate are sometimes displaced. Accordingly, the work space needs to be rendered larger in view of the need to allow for displacement. This results in a problem that densification of the multilayer circuit board is made difficult.

Additionally, when the insulating substrates are stacked on the core board, the pressing sometimes causes misregistration between the core substrate and each insulating board. Accordingly, an X-ray check hole needs to be previously formed so that the location of the inner conductor circuit is checked from the surface of the insulating board. This necessitates one extra step in the manufacture.

BRIEF SUMMARY OF THE INVENTION

The first embodiment of the invention is a method of manufacturing a multilayer circuit board, in which a plurality of printed boards are stacked and pressed into a multilayer circuit board, each printed board having a conductor layer on one side of an insulating layer, characterized by the steps of stacking the printed boards with a bonding layer being interposed between the printed boards, and stacking an outermost conductor layer on an insulating layer side of a first outermost printed board with a bonding layer being interposed therebetween and pressing a stack so that the printed boards and the outermost conductor layer are bonded together, the first outermost printed board being disposed with the insulating layer side being directed outward.

Another embodiment of the invention is characterized in that the printed boards include a second outermost printed board disposed with a conductor layer side being directed outward, the conductor layer being pressed under a condition as to ensure that the conductor layer has a uniform thickness throughout.

According to the first embodiment, the printed boards each of which has one side formed with a conductor layer are stacked. The outermost conductor layer is stacked on the insulating layer side of the first outermost printed board disposed with the insulating layer side being directed outward. The printed boards are collectively pressed to be manufactured into a multilayer circuit board. Accordingly, the multilayer circuit board is manufactured by a single pressing operation. Consequently, the manufacturing steps can be simplified and the manufacturing efficiency can be improved.

Furthermore, since pressing is carried out just once, the possibility that the insulating substrate may be distorted and the possibility that the printed board may be shifted can be rendered minimum. Consequently, the precision of the multilayer circuit board can be improved.

According to the second embodiment of the invention, the second outermost printed board is not previously etched and pressed under the condition where the thickness thereof is entirely uniform. Accordingly, since a uniform pressure is applied to the whole printed board in the pressing, the possibility of distortion and displacement can be rendered minimum. Consequently, the precision of the multilayer circuit board can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view (1) showing steps of manufacturing a multilayer circuit board in accordance with the present invention;

FIG. 2 is a sectional view (2) showing steps of manufacturing a multilayer circuit board in accordance with the present invention; and

FIG. 3 is a sectional view (3) showing steps of manufacturing a multilayer circuit board in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

One embodiment of the present invention will be described with reference to FIGS. 1 to 3.

In the method of manufacturing the multilayer circuit board 1 in accordance with the present invention, a plurality of printed board 2 are stacked and collectively pressed. The method is characterized by stacking an outermost copper foil 6 (corresponding to an outermost conductor layer of the present invention) on a side of a first outermost printed board 2A at an insulating substrate 4A side and pressing, the printed board 2A having an insulating substrate 4 (corresponding to an insulating layer in the present invention) side being directed outward. See FIG. 2(G).

The method is further characterized in that a copper foil 5B of a second outermost printed board 2B disposed with the copper foil 5B (corresponding to a conductor layer in the present invention) side being directed outward is not previously formed with a conductor circuit 10 and is pressed under a condition where the copper foil 5B remains on the entire side.

The manufacture of the printed board 2 forming the multilayer circuit board 1 starts with a one-side copper-clad laminate 3. The one-side copper-clad laminate 3 has a well known structure, that is, the copper foil 5 is affixed to one side of an insulating substrate 4 (the underside in FIG. 1) made of a plate-shaped glass-cloth epoxy resin (FIG. 1(A)).

Laser beams are irradiated onto prescribed locations on the insulating substrate 4 from the side of the substrate opposite the copper foil 5 (the upper side in FIG. 1) so that via holes 7 extending through the insulating substrate to the copper foil 5 are formed (FIG. 1(B)). The laser beam machining is executed by a pulse oscillation CO₂ gas laser, for example. In this case, the pulse energy preferably ranges between 2.0 and 10.0 mJ, the pulse width preferably ranges between 1 and 100 μ s, the pulse interval is preferably at or above 0.5 ms, and the number of shots preferably ranges between 3 and 50.

Thereafter, desmearing is carried out in order that the resin remaining in the via holes 7 may be removed. The desmearing includes a treatment of potassium permanganate, oxygen plasma discharge, corona discharge process, etc.

Subsequently, the copper foil 5 is covered with a protecting film made from polyethylene terephthalate although this state is not shown. In this state, a plated conductor 8 is formed in each via hole 7 by an electroplating with the copper foil 5 serving as one of electrodes (FIG. 1(C)). An amount of conductor 8 filling each via hole 7 is preferably determined so that an upper face thereof is slightly lower than the surface of the insulating substrate 4. Copper is most preferably as a plated metal, but any metal which can be plated may be used, such as tin, silver, solder, alloy of copper and tin, alloy of copper and silver, etc.

An electrically conductive bump 9, comprising a material with a low melting point, such as tin, is formed by means of bump plating so that the bump overlaps the plated conductor 8 in each via hole 7. Each conductive bump 9 is formed so as to project slightly from the upper surface of the insulating substrate 4 (FIG. 1(D)). Subsequently, the copper foil 5 is etched so that a conductor circuit 10 is formed after the protecting film is stripped from the copper foil 5 (FIG. 1(E)).

A thermosetting adhesive (epoxy resin adhesive, for example) is applied by roll coating to the side of the printed board 2 on which the conductive bumps 9 are formed, whereby an adhesive layer 11 is formed (FIG. 1(F)).

A plurality of printed boards 2 manufactured as described above are aligned and overlapped (FIG. 2G). A second outermost printed board 2B of the top layer is overlapped without being etched. Accordingly, the copper foil 5 remains on the printed board 2B with a uniform thickness over the whole surface. The printed board 2B is disposed so that the copper foil 5 is directed outward (upward in FIG. 2) and the conductive bumps 9 are directed inward. The printed board 2 located below the printed board 2B is stacked so that the conductor circuits 10 are positioned at the upper side of the printed board 2. Thus, the printed boards are stacked so that the conductive bumps 9 of the printed board 2 located on top are connectable to the conductor circuits 10 of the lower printed board 2. Additionally, a first outermost printed board 2A located lowermost is stacked so that the insulating substrate 4A side formed with the adhesive layer is directed outward (downward in FIG. 2). An outermost copper foil 6 is stacked on the surface of the printed board 2A.

The printed boards thus stacked are heated and pressed under vacuum at 180°C for 70 minutes so that the adhesive layer 11 is hardened, whereby the printed boards 2, 2A and 2B, and the outermost copper foil 6 are bonded together. The multilayer circuit board 11 in which the printed boards 2, 2A and 2B and outermost copper foil 6 are integrated is manufactured by one pressing operation (FIG. 2(H)). The distal ends of the conductive bumps 9 of each printed board are connected to prescribed locations of the conductor circuit 10 on the adjacent printed board 2, whereupon the conductor circuits 10 of the adjacent printed boards 2 are electrically connected to each other.

Subsequently, the copper foil 5 on the uppermost side and the outermost copper foil 6 affixed to the underside are etched so that conductor circuits 10 are formed (FIG. 3(I)).

A photosensitive solder resist 12 is applied to the whole underside and exposure and development processes are applied to the solder resist in a prescribed pattern so that the solder resist 12 is formed with openings which open lands formed at prescribed locations on the conductor circuit 10. Pins 13 for connecting the multilayer circuit board 1 to other components are bonded to the lands by solder 14. The multilayer circuit board 1 is thus manufactured.

According to the foregoing embodiment, the multilayer circuit board 1 is manufactured by stacking a plurality of printed boards 2 and stacking the outermost copper foil 6 on the insulating substrate 4A side of the first outermost printed board 2A disposed with the insulating substrate side being directed outward, and collectively pressing the stack. Accordingly, the multilayer circuit board 1 can be manufactured by a single pressing. Consequently, manufacturing steps can be simplified and the precision of the multilayer circuit board can be improved.

Furthermore, since pressing is carried out just once, the possibility that the insulating substrate 4 and the via holes 7 may be displaced can be rendered minimum. Consequently, the precision of the multilayer circuit board can be improved.

Furthermore, the copper foil 5B of the second outermost printed board 2B disposed with the copper foil side being directed outward is not previously etched, and the printed board 2B is pressed under the condition where the copper foil 5B has a uniform thickness throughout. Accordingly, a uniform pressure can be applied to the whole printed board 2, thereby minimizing the possibility that the inner printed board 2 may be shifted or distorted. Consequently, the precision of the multilayer circuit board 1 can be improved.

The method of manufacturing a multilayer circuit board 1 just described can be used to manufacture electronic packages requiring a particularly high precision. The underside on which the pins 13 are provided is preferably the outermost copper foil 6 side. The precision

required for the lower layer side is lower than the precision required for the upper layer side and accordingly, the precision does not result in a problem even if the outermost copper foil 6 is stacked on the lowermost layer and pressed.

The technical scope of the present invention should not be limited by the above-described embodiment and covers equivalents thereof.

INDUSTRIAL APPLICABILITY

The present invention can provided a method of manufacturing a multilayer circuit board which can simplify the manufacturing steps and improve the precision of the multilayer circuit board.